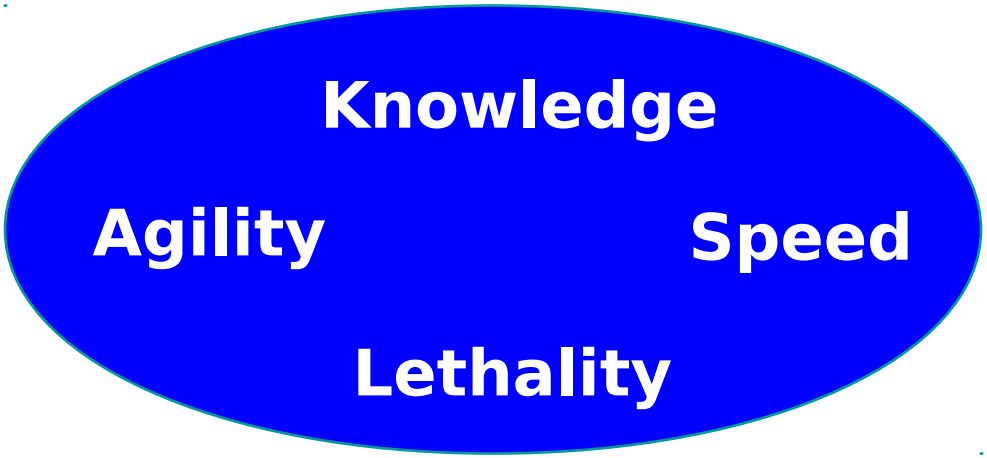
Defense Research and Engineering Update

6th Annual Science and Engineering Technology Conference

Dr. Ronald M. Sega
Director of Defense Research and Engineering

April 19, 2005

Technology and Transformatio
Transformational Attributes



- **DDR&E Transformation Technology Initia**
  - **National Aerospace Initiative**
  - **Energy and Power Technologies**
  - **Surveillance and Knowledge Systems**

Research and Engineering Goals

- **Purpose: Ensure the United States Armed Forces will have decisive technological capability advantages over potential adversaries**
- **Goals demonstrate advances in near-term capability while maintaining a steady flow of technology options for the future force**
- **Goals are characterized as Process, Technical Capability, and Enabling Technology**

Research and Engineering Goals

Process Goals

R&E Program shall:

- **Focus on transitioning military relevant technology to the warfighter**
- **Support the education of more scientists and engineers**
- **Increase emphasis on near-term technologies that can be accelerated and transitioned to meet immediate warfighting needs**
- **Shall archive and reuse information generated by the global R&E community (utilize DTIC)**
- **Develop an improved capability to affordably build military systems through improved systems engineering**

DoD shall:

- **Sustain an investment in university research**
- **Support strategic investments in technologies supporting irregular, catastrophic, and disruptive technologies**

Research and Engineering Goals

Technical Capability Goals

- **Divided into five areas:**
  - **Protection**
  - **Force Sustainment**
  - **Situation Awareness**
  - **Strike**
  - **Cross-Cutting**

Research and Engineering Goals

Technical Capability Goals

Protection

Develop technologies to:

- **Increase capability to detect, identify movement of, and mitigate WMD**
- **Extend the safe zone around bases of critical infrastructure**
- **Provide effective cruise and ballistic missile defense against LO and/or high speed targets**

Force Sustainment

Develop technologies to:

- **Reduce logistics or manpower demands on existing forces and increase the life-span of current weapons**
- **Enable rapid force projection and deployment**

Research and Engineering Goals

Technical Capability Goals

Situation Awareness

- Develop information technologies to provide robust, reliable, survivable and secure, self-forming networks
- Develop C4ISR technologies to increase the capability to find, fix, track and identify friendly/enemy forces in real time

Strike

- Develop technologies to support the fielding of alternative strike weapons for both conventional weapons and hard target defeat.

Cross-Cutting

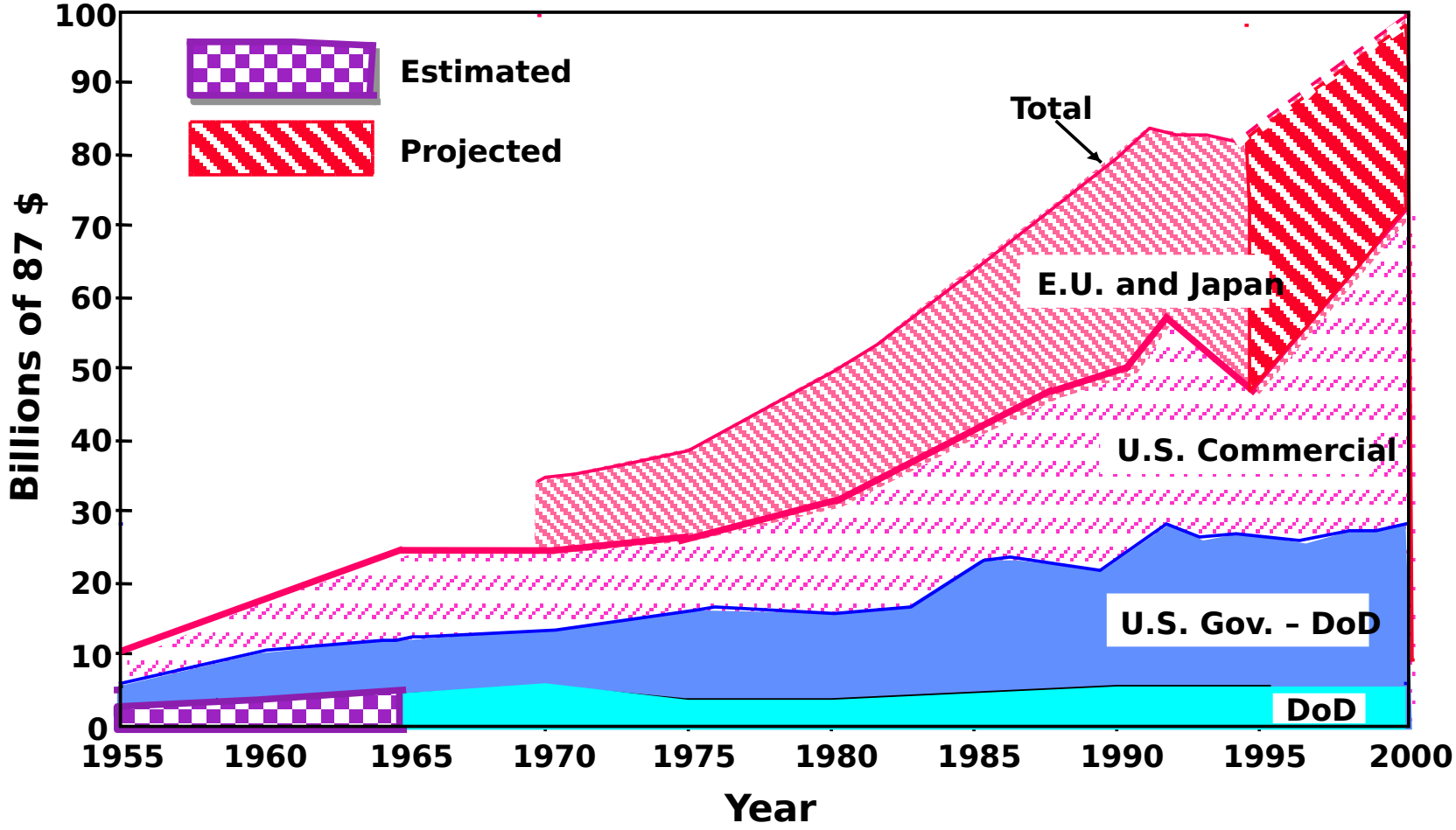
- Reduce the cost and time required for space launch through the pursuit of reusable vehicles
- Enhance the realism, effectiveness, and accessibility of training and mission rehearsal

Research and Engineering Goals

Enabling Technology Goals

- **Nanotechnology**
- **Biotechnology**
- **Unmanned and autonomous vehicles**
- **Quantum communications/computing technology**
- **Networked Systems**
- **Advanced Materials**
- **Intellectual Capital (Workforce)**
- **DoD R&E Infrastructure**
- **Modeling, simulation, computation and software for complex systems**

Worldwide Research Base is Growing



Source: Report of the Defense Science Board Task Force on the Technology Capabilities of Non-DoD Providers; June 2000; Data provided by the Organization for Economic Cooperation and Development & National Science Foundation

Global S&T Development

Every DoD Researcher, Acquisition Professional, Tester, and Operator should be able to sit down at their Desktop computer and be able to find out:

-- What the DoD is doing in R&E

-- Why we are doing the work

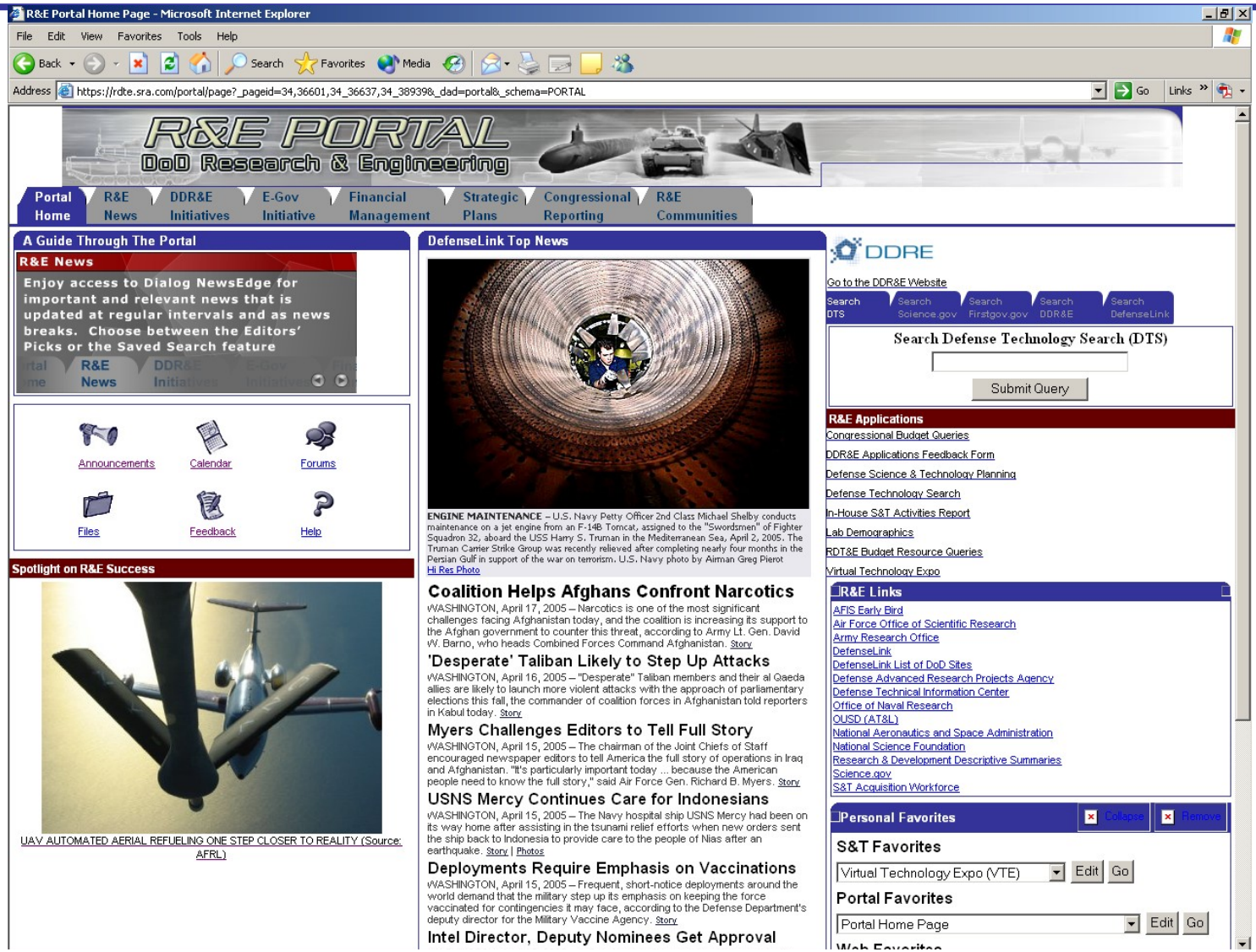
-- When the work will be done

-- Who knows more about this information

-- What everyone else in doing in R&E

"Smarter Google" for the RDT&E and Warfighter Community

R&E Portal
https://rdte.osd.mil


R&E Portal Home Page - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites Media
Address https://rdte.sra.com/portal/page?_pageid=34,36601,34_36637,34_38939&_dad=portal&_schema=PORTAL
Go Links
R&E PORTAL
DoD Research & Engineering
Portal Home
R&E News
DDR&E Initiatives
E-Gov Initiative
Financial Management
Strategic Plans
Congressional Reporting
R&E Communities
A Guide Through The Portal
R&E News
Enjoy access to Dialog NewsEdge for important and relevant news that is updated at regular intervals and as news breaks. Choose between the Editors' Picks or the Saved Search feature
Announcements
Calendar
Forums
Files
Feedback
Help
Spotlight on R&E Success
UAV AUTOMATED AERIAL REFUELING ONE STEP CLOSER TO REALITY (Source: AFRL)
DefenseLink Top News
ENGINE MAINTENANCE – U.S. Navy Petty Officer 2nd Class Michael Shelby conducts maintenance on a jet engine from an F-14B Tomcat, assigned to the "Swordsmen" of Fighter Squadron 32, aboard the USS Harry S. Truman in the Mediterranean Sea, April 2, 2005. The Truman Carrier Strike Group was recently relieved after completing nearly four months in the Persian Gulf in support of the war on terrorism. U.S. Navy photo by Airman Greg Pierot
Hi Res Photo
Coalition Helps Afghans Confront Narcotics
WASHINGTON, April 17, 2005 – Narcotics is one of the most significant challenges facing Afghanistan today, and the coalition is increasing its support to the Afghan government to counter this threat, according to Army Lt. Gen. David W. Barno, who heads Combined Forces Command Afghanistan. Story
'Desperate' Taliban Likely to Step Up Attacks
WASHINGTON, April 16, 2005 – "Desperate" Taliban members and their al Qaeda allies are likely to launch more violent attacks with the approach of parliamentary elections this fall, the commander of coalition forces in Afghanistan told reporters in Kabul today. Story
Myers Challenges Editors to Tell Full Story
WASHINGTON, April 15, 2005 – The chairman of the Joint Chiefs of Staff encouraged newspaper editors to tell America the full story of operations in Iraq and Afghanistan. "It's particularly important today ... because the American people need to know the full story," said Air Force Gen. Richard B. Myers. Story
USNS Mercy Continues Care for Indonesians
WASHINGTON, April 15, 2005 – The Navy hospital ship USNS Mercy had been on its way home after assisting in the tsunami relief efforts when new orders sent the ship back to Indonesia to provide care to the people of Nias after an earthquake. Story | Photos
Deployments Require Emphasis on Vaccinations
WASHINGTON, April 15, 2005 – Frequent, short-notice deployments around the world demand that the military step up its emphasis on keeping the force vaccinated for contingencies it may face, according to the Defense Department's deputy director for the Military Vaccine Agency. Story
Intel Director, Deputy Nominees Get Approval
DDRE
Go to the DDR&E Website
Search DTS
Search Science.gov
Search Firstgov.gov
Search DDR&E
Search DefenseLink
Search Defense Technology Search (DTS)
Submit Query
R&E Applications
Congressional Budget Queries
DDR&E Applications Feedback Form
Defense Science & Technology Planning
Defense Technology Search
In-House S&T Activities Report
Lab Demographics
RDT&E Budget Resource Queries
Virtual Technology Expo
R&E Links
AFIS Early Bird
Air Force Office of Scientific Research
Army Research Office
DefenseLink
DefenseLink List of DoD Sites
Defense Advanced Research Projects Agency
Defense Technical Information Center
Office of Naval Research
OUSD (AT&L)
National Aeronautics and Space Administration
National Science Foundation
Research & Development Descriptive Summaries
Science.gov
S&T Acquisition Workforce
Personal Favorites
Collapse
Remove
S&T Favorites
Virtual Technology Expo (VTE)
Edit
Go
Portal Favorites
Portal Home Page
Edit
Go

A National Issue

- **"An Emerging and Critical Problem of the Science and Engineering Workforce"[1]**
  - **12 Major studies (1999-2004) make essentially the same point**
  - **A few studies did not consider security clearance needs and rely on relaxation of immigration rules**

- **Growing need for U.S. citizens in national security activities**

1. **National Science Board Companion Paper to "National Science and Engineering Indicators 2004", National Science Foundation, April 2004**

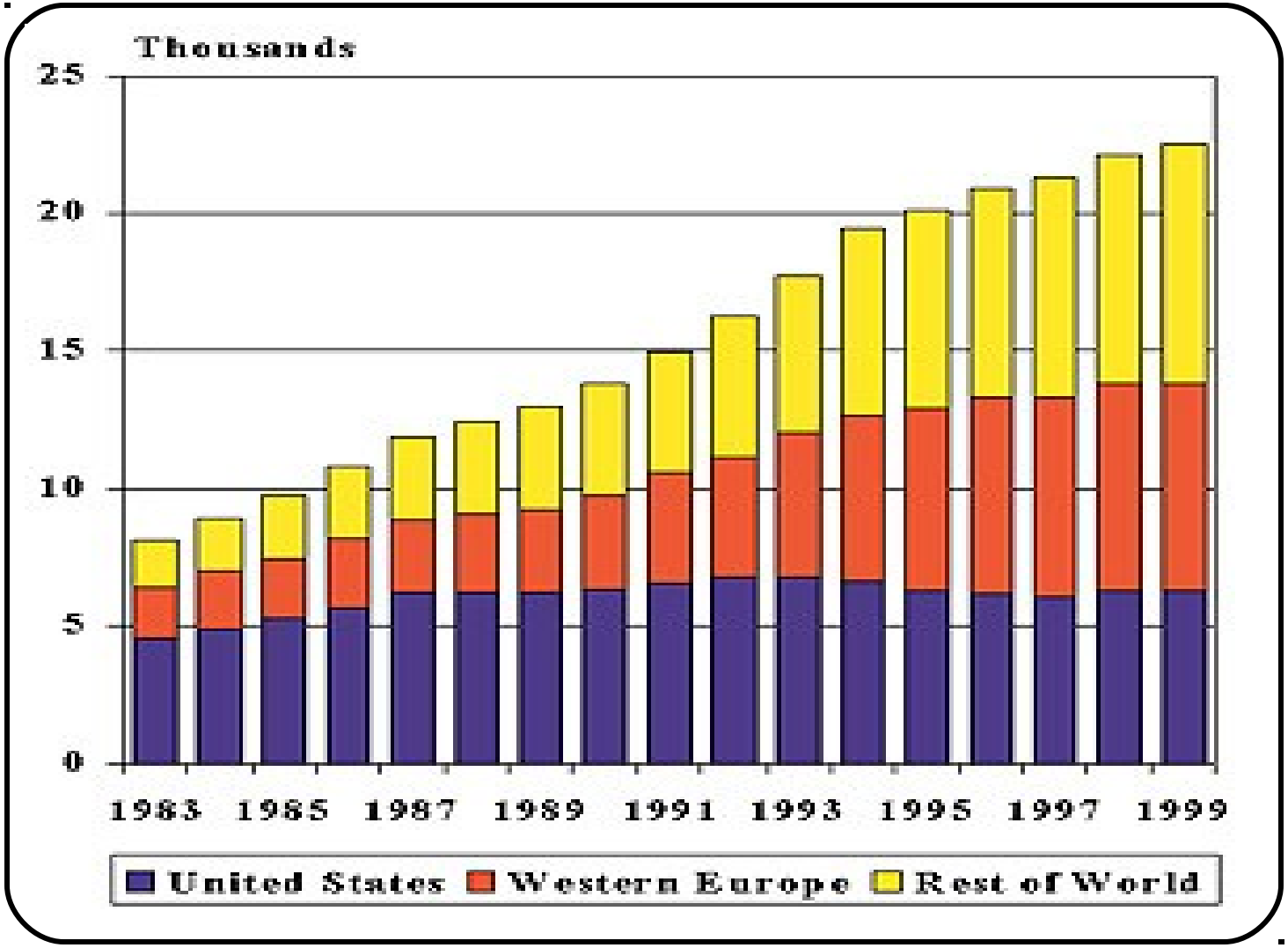
DoD Scientists & Engineers (S&E)

- **“Attrition” in DoD labs: ~13,000 Science and Engineering departures projected within 10 years**
- **The number of clearable students pursuing defense-related critical skills degrees and is declining**
- **Projected U.S. demand for S&E’s will be up 10% by 2010 (Bureau of Labor Statistics 2001)**

Physical Review Trends

Physical Review & Physical Review Letters

Total Submissions



Source: American Physical Society - *APS News August/September 2000*

DoD S&Es as % of Total Fed S&Es

Source: Pre-release - OPM data for NSF pub, Table B-14. Federal scientists and engineers, by agency and major occupational group: 1999-2002

	1999	2000	2001	2002
Total S&Es	44.2%	43.5%	43.1%	43.4%
All sci	26.1%	25.4%	25.6%	26.9%
Comp/Math sci	45.5%	43.9%	44.0%	45.3%
Life sci	11.4%	11.2%	11.0%	10.9%
Physical sci	26.7%	26.2%	26.1%	26.2%
Social sci	20.4%	20.4%	19.7%	19.6%
All eng	66.7%	66.4%	66.2%	66.7%
Aerospace	44.7%	43.6%	43.0%	42.8%
Chemical	62.3%	63.6%	65.7%	67.6%
Civil	61.8%	61.3%	60.6%	60.1%
EE&Comp	79.3%	79.1%	78.5%	79.1%
Industrial	81.1%	80.2%	79.4%	79.4%
Mechanical	88.2%	88.2%	88.4%	89.2%
Other eng	54.6%	55.1%	55.5%	55.9%

DoD Percent of Federal Research

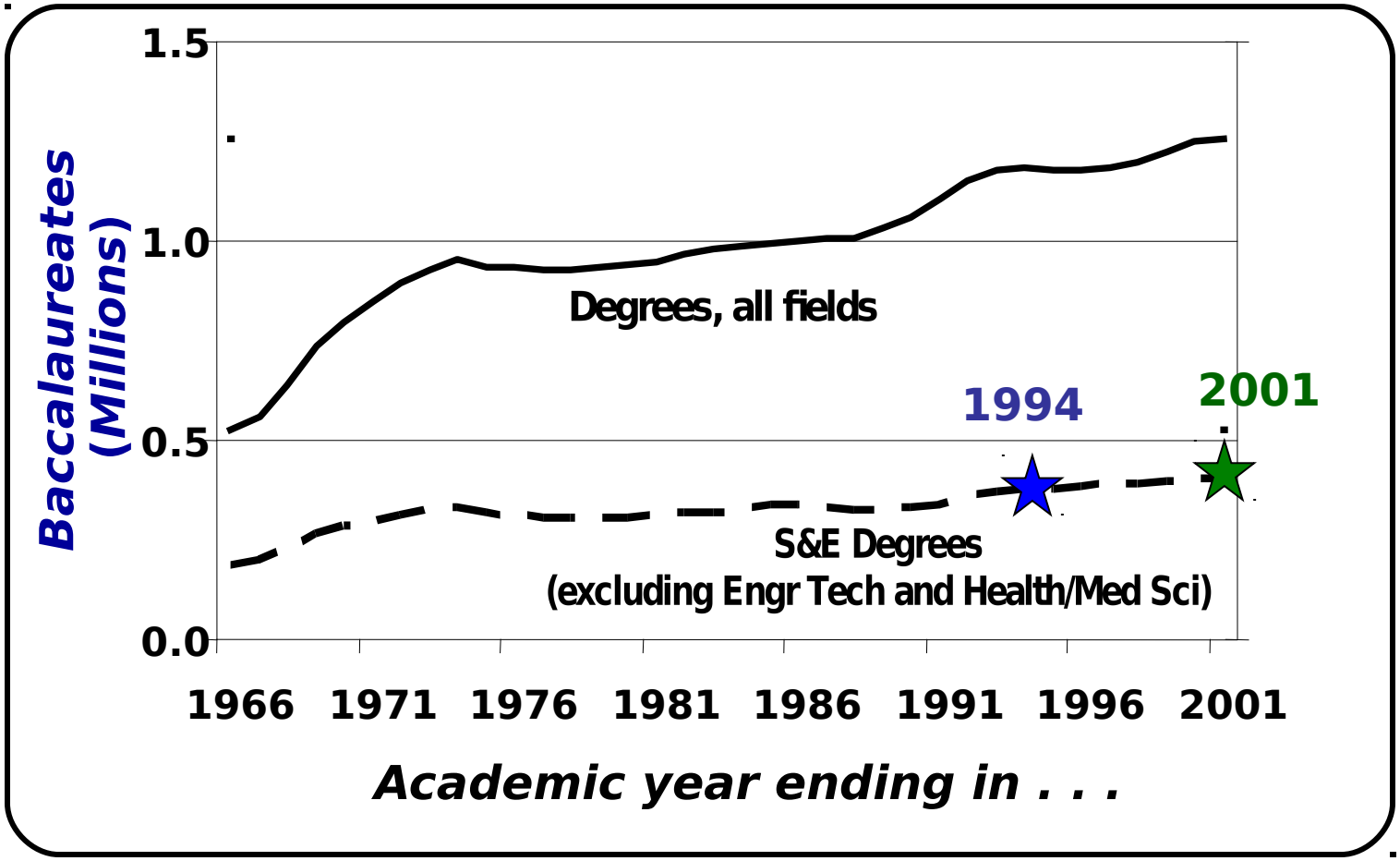
Basic and Applied Research (FY01)

	Fed Total	Univ. Research	Univ. Basic	Univ. Applied
Aeronautical	44%	51%	26%	75%
Astronautical	16%		45%	5%
Electrical Engineering	81%	13%	72%	66%
Mechanical Engineering	78%	71%	74%	70%
Metallurgy & Materials	46%	74%	34%	76%
Civil Engineering	23%	44%	2%	15%
All Engineering	44%	5%	38%	54%
Mathematics	21%	43%	11%	21%
Computer Science	37%	13%	11%	88%
		34%		
All Fields of Research	15%	9%	10%	9%

Source: Federal Funds for R&D, NSF Report #04-310

U.S. Production of S&E Graduates*

U.S. College and University Graduates, 1966-2001



*Source: Data provided by the NSF, September 2003

U.S. University Trends in Defense-Related S&E *Graduate Student Enrollment (1994-2001)*

ce: National Science Foundation – Graduate Students and Post Doctorates in Science and Engineering: Fall

Science Disciplines

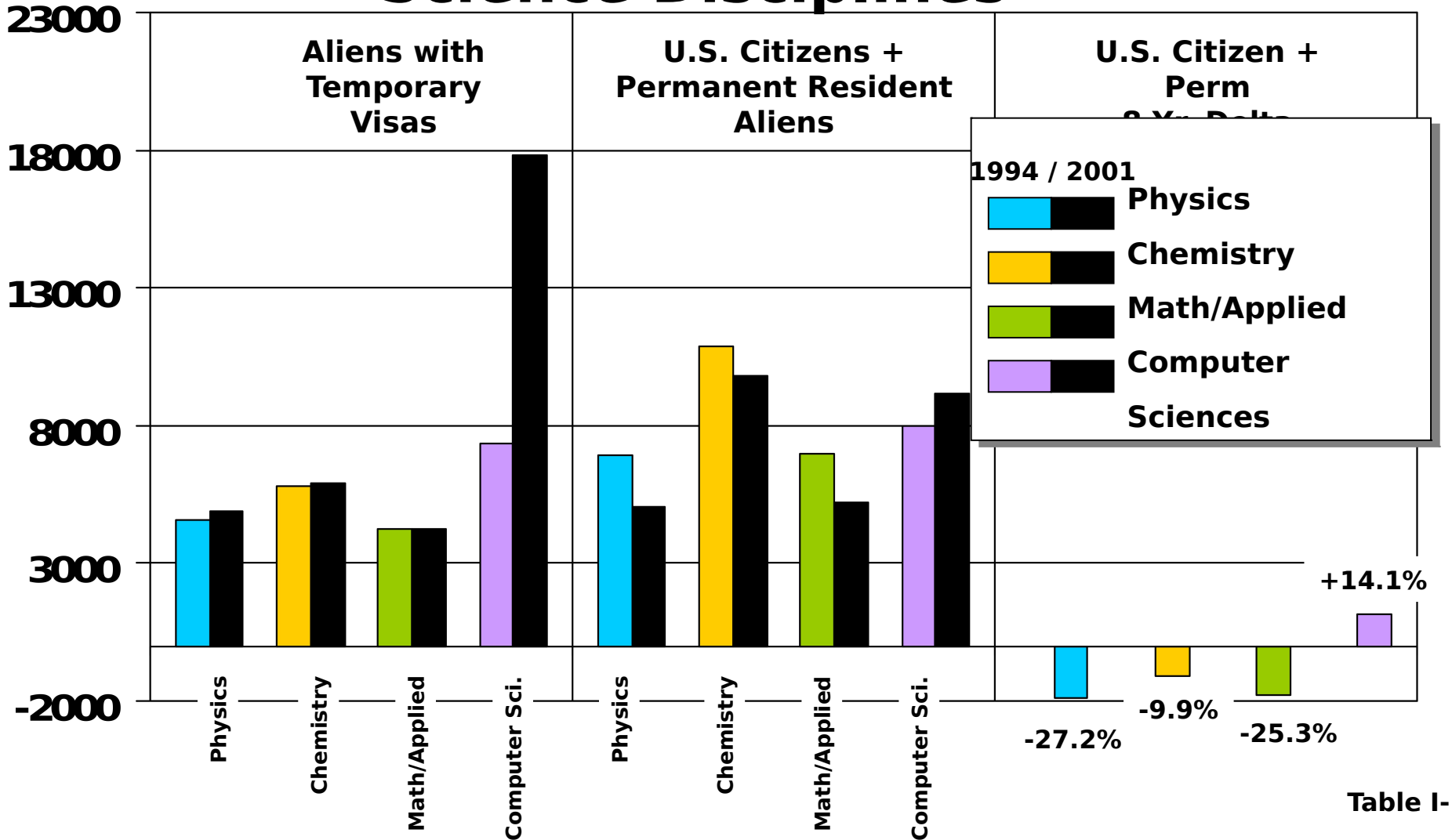


Table I-

U.S. University Trends in Defense-Related S&E *Graduate Student Enrollment (1994-2001)*

ce: National Science Foundation – Graduate Students and Post Doctorates in Science and Engineering: Fall

Engineering Disciplines

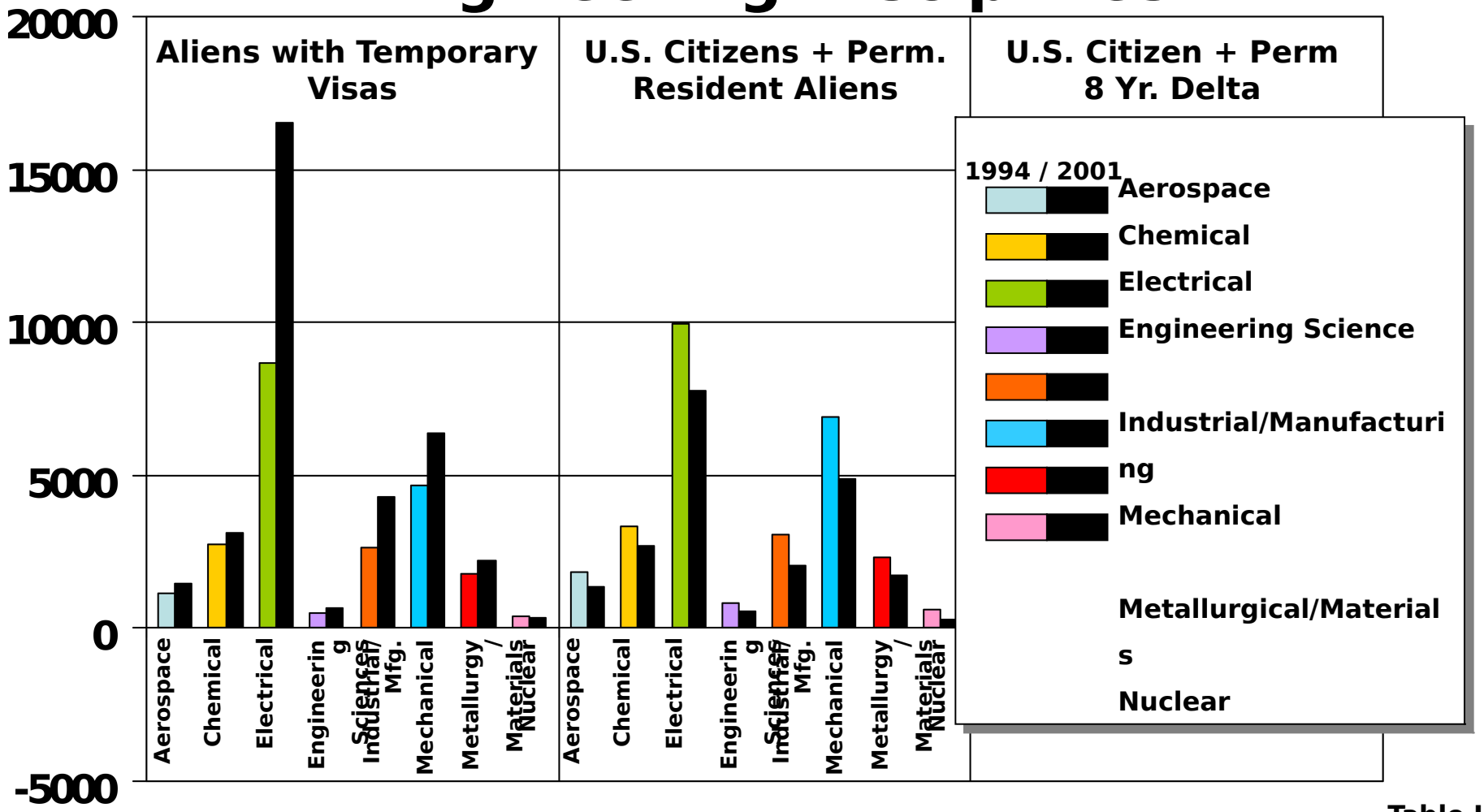


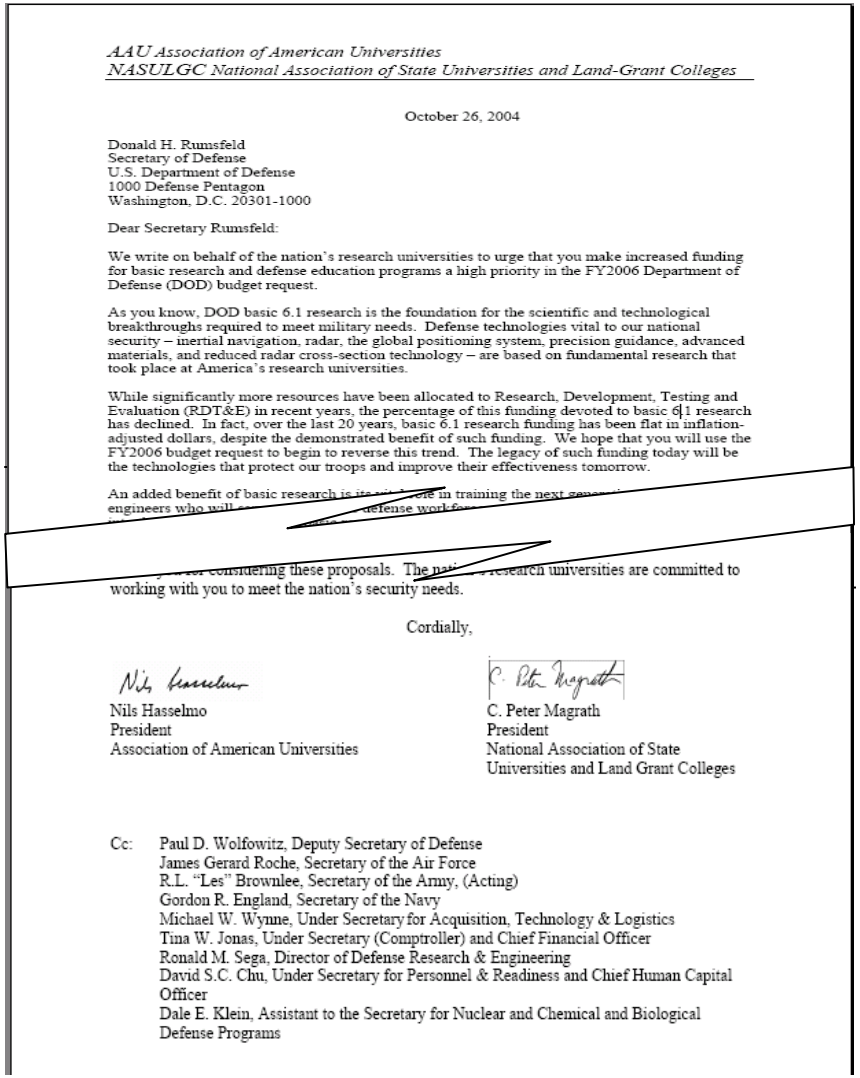
Table III

Science, Mathematics and Research for Transformation (SMART)

- **SMART Legislation Passed (NDAA 2005)**
- **Elements of the Pilot Program**
  - **US Citizens**
  - **Scholarship/Fellowship: Bachelors, Masters, PhD**
  - **Defense related critical disciplines**
  - **Payback required - Employment after Degree**
- **Implementation**
  - **Broad Participation (Army, Navy, AF, DARPA, DISA, DTRA)**
  - **Preliminary selections made April 13, 2005**

AAU Letter to Secretary Rumsfeld

- Supported increased funding for Research
- Defense Education Programs
- 6.1 research is foundation for S&T breakthroughs
- Future challenges cannot be met without appropriately educated and trained workforce
- Specific support for SMART
- Specific support for



AAU Association of American Universities
NASULGC National Association of State Universities and Land-Grant Colleges

October 26, 2004

Donald H. Rumsfeld
Secretary of Defense
U.S. Department of Defense
1000 Defense Pentagon
Washington, D.C. 20301-1000

Dear Secretary Rumsfeld:

We write on behalf of the nation's research universities to urge that you make increased funding for basic research and defense education programs a high priority in the FY2006 Department of Defense (DOD) budget request.

As you know, DOD basic 6.1 research is the foundation for the scientific and technological breakthroughs required to meet military needs. Defense technologies vital to our national security – inertial navigation, radar, the global positioning system, precision guidance, advanced materials, and reduced radar cross-section technology – are based on fundamental research that took place at America's research universities.

While significantly more resources have been allocated to Research, Development, Testing and Evaluation (RDT&E) in recent years, the percentage of this funding devoted to basic 6.1 research has declined. In fact, over the last 20 years, basic 6.1 research funding has been flat in inflation-adjusted dollars, despite the demonstrated benefit of such funding. We hope that you will use the FY2006 budget request to begin to reverse this trend. The legacy of such funding today will be the technologies that protect our troops and improve their effectiveness tomorrow.

An added benefit of basic research is its [illegible] in training the next [illegible] engineers who will [illegible] defense work [illegible]

[illegible] considering these proposals. The nation's research universities are committed to working with you to meet the nation's security needs.

Cordially,

Nils Hasselmo
President
Association of American Universities

C. Peter Magrath
President
National Association of State
Universities and Land Grant Colleges

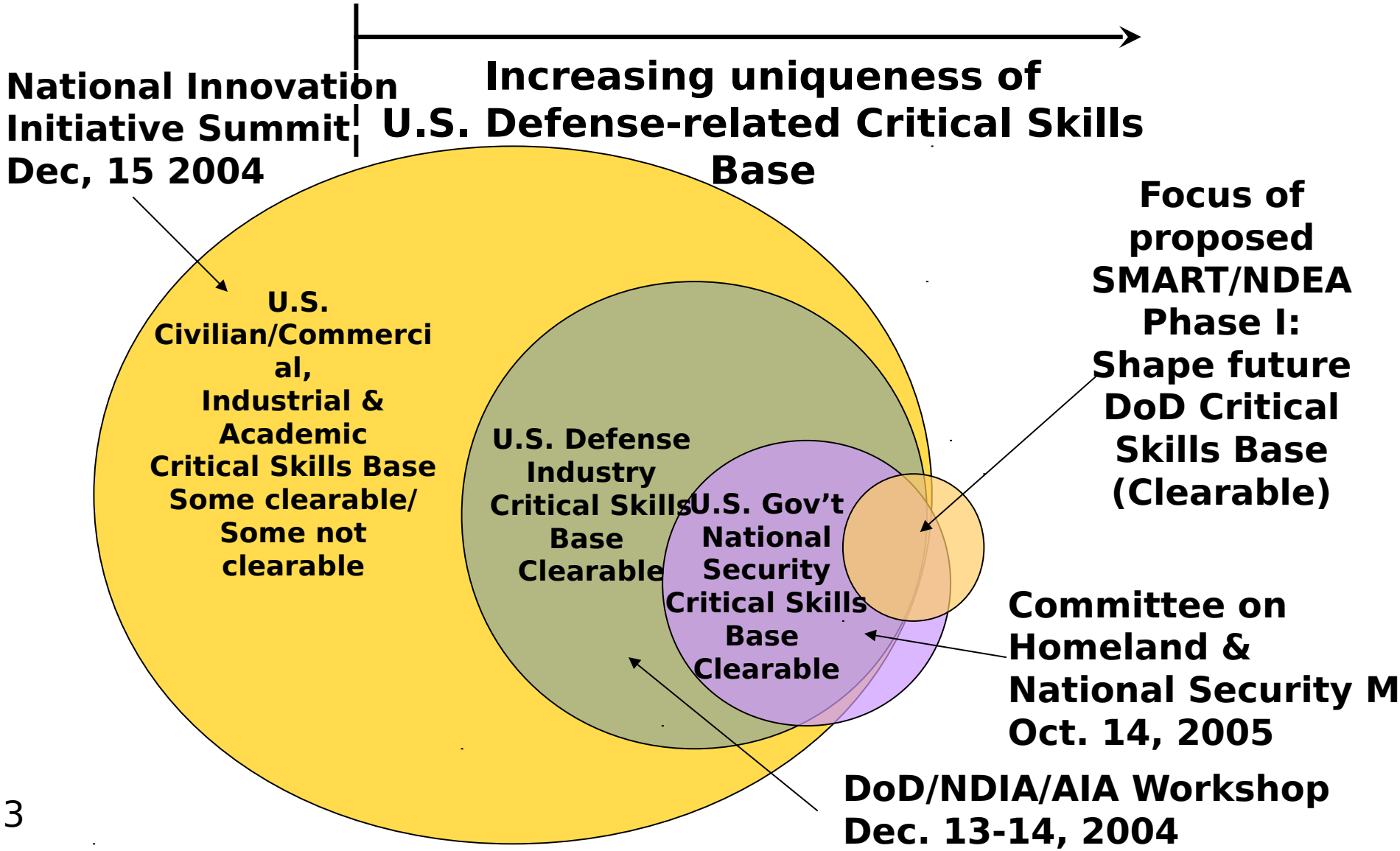
Cc: Paul D. Wolfowitz, Deputy Secretary of Defense
James Gerard Roche, Secretary of the Air Force
R.L. "Les" Brownlee, Secretary of the Army, (Acting)
Gordon R. England, Secretary of the Navy
Michael W. Wynne, Under Secretary for Acquisition, Technology & Logistics
Tina W. Jonas, Under Secretary (Comptroller) and Chief Financial Officer
Ronald M. Sega, Director of Defense Research & Engineering
David S.C. Chu, Under Secretary for Personnel & Readiness and Chief Human Capital Officer
Dale E. Klein, Assistant to the Secretary for Nuclear and Chemical and Biological Defense Programs

Proposed Defense Education Activities for FY06

- **FY06 President's Budget Request (PBR)**
  - **SMART/National Defense Education Act (NDEA) – Phase I submitted**
  - **Elements of SMART Pilot Program made permanent**
  - **Funding Request: $10M for FY06 ($2.5M in FY05)**
- **Additional Options Under Consideration**
  - **Adding Associates degree**
  - **Option for DoD to employ students during course of study**
  - **Expanded allowable expenses (i.e. Research Support & Equipment)**
  - **Clearance process could begin during course of study**
  - **Summer Internships**
  - **Critical technical disciplines and foreign language**

Initial DoD Critical Skills Focus

Proposed SMART/NDEA Phase 1 Relative to Other U.S. Sectors


National Innovation Initiative Summit Dec, 15 2004
Increasing uniqueness of U.S. Defense-related Critical Skills Base
U.S. Civilian/Commercial, Industrial & Academic Critical Skills Base Some clearable/ Some not clearable
U.S. Defense Industry Critical Skills Base Clearable
U.S. Gov't National Security Critical Skills Base Clearable
Focus of proposed SMART/NDEA Phase I: Shape future DoD Critical Skills Base (Clearable)
Committee on Homeland & National Security Mt
Oct. 14, 2005
DoD/NDIA/AIA Workshop
Dec. 13-14, 2004

Summary

- **The DoD R&E program remains focused on transformation**
- **Instituted R&E Goals**
- **Need to expand global outreach and make information easier to access**
- **Workforce Development is a collaborative effort between Government, Industry, and Academia**

BACKUP

The Challenge: Pace of Technology

"Moore's Law" → **Computing doubles every 18 months**

"Fiber Law" → **Communication capacity doubles every 9 months**

"Disk Law" → **Storage doubles every 12 months**

Defense Acquisition Pace

F-22 **Milestone I: Oct 86** **IOC: Dec 05***

Comanche **Milestone I: Jun 89** **IOC: Sep 09**

*** Computers at IOC are 512 X faster, hold 65,000 X bits of information than they did at MS I**

Technology growth is non-linear…
Acquisition path has been linear

Global S&T Development

- **The rise in global science and technology (S&T) development over the last decade has produced a research and engineering (R&E) landscape that is more dynamic and is experiencing an increasing rate of change.**

- **Understanding the global research and engineering landscape is critical to maintaining a vigorous, responsive and productive U.S. defense research and development program, which provides technology enablers for present and future capabilities for operational forces.**